House Committee on Oversight and Government Reform

Subcommittee on National Security and Foreign Affairs Hearing

"GPS: Can We Avoid a Gap in Service?"

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I would like to thank Chairman Tierney, Ranking Member Flake, and distinguished members of this Subcommittee, for providing an opportunity today to provide input on this important topic.

The Global Positioning System is a vital U.S. military space capability and a source of strategic national advantage to U.S. forces. It is also an increasingly vital part of several critical infrastructures for air transportation, maritime shipping, electrical power, communications, natural resource management, and emergency responders at the federal, state, and local levels. The continued stability, health, and protection of GPS capabilities are thus vital to a wide range of national interests.

GPS is a successful dual-use technology that has benefited from Air Force operational stewardship and bipartisan policy support across multiple Administrations and sessions of Congress. It is a notable and all too rare example of domestic as well as international cooperation with benefits to the national security, civil, commercial, scientific, and international communities that use GPS. This success has been due to an enlightened sense of national self-interest that includes civil as well as military concerns and a willingness to encourage market-driven innovation through open, stable technical standards. GPS has been correctly characterized by U.S. policy as a public good that uses information technology to enhance the productivity of many infrastructures and systems rather than a narrow aerospace, consumer, or sector-specific service.

Emerging foreign systems such as Galileo in Europe and Compass in China have the potential to complement GPS and benefit all GPS users if care is taken to ensure there is no harm to the military utility of GPS and commercial innovation continues to be market-driven. Per U.S. policy guidance, the State Department has taken a leading role in crafting cooperative relations with Japan, India, Russia, and Europe. China is also an increasingly important part of multilateral discussions among satellite navigation providers.

The topic of this hearing is "Can we avoid a gap in service?" and given the well-known challenges faced by civil and military space systems, it is a timely question to ask. The GPS program is undergoing a transition to a new generation of satellites, GPS Block III. The highest priority needs to be placed on the timely and successful deployment of the GPS IIIA satellites and the prompt movement to the GPS IIIB series. These satellites will carry a variety of modernized signals and capabilities that are vital for all users, civilian and military. Foreign systems cannot compensate for gaps in the deployment of GPS III even without considering the serious national security and economic concerns from such reliance.

Rather than a technical description of GPS services, I would like to characterize the positioning, navigation, and timing services in terms of three qualities: accuracy, availability, and reliability.

Accuracy – means more than just the meters-level positioning provided by consumer devices, but also encompasses the real-time centimeter-level accuracy used in precision surveying and construction. It means the millimeter-level accuracy achievable by scientific users in conjunction with other technologies to understand the motion of the Earth's surface and behavior of the oceans. This level of accuracy requires precise knowledge of the GPS constellation in space, stable GPS signals, and *stable relationships between the signals* so as to extract the most accurate position information possible from the system.

Availability – normally means that there are enough satellites visible to a user anywhere in the world to provide good geometry for positioning and navigation. In addition, each satellite must itself have a full complement of working subsystems and on Earth the radio frequency spectrum must remain clean and relatively free of interference, whether intentional or unintentional. One

can have many satellites in orbit but if their subsystems are failing or the spectral "noise floor" is too high, then the GPS service will not be available.

Reliability – has an obvious technical meaning in terms of the GPS signals, but it also includes policy and program management considerations. Users around the globe place their trust in the operators of the GPS space and ground segments as well as the government authors of the "Interface Specifications" or ISs that describe current GPS signals as well as the modernized signals. If the ISs are wrong, ambiguous, or unstable, that undermines the effective reliability of GPS by undermining the trust that global users have placed in GPS.

A decision to make an investment in using and relying on GPS, sometimes for very critical public safety or economic applications requires a high degree of trust. The open, transparent specification of GPS signal characteristics (not the sensitive technology that creates the signals) has helped create that necessary trust. Public and private investment decisions have in turn enabled market-driven competition to drive down prices and drive up performance to the benefit of all users, civilian and military.

As GPS moves to modernized civilian signals such as L2C, L5, and future L1C the United States needs to continue to provide stable, open specifications for civil signals that encourage adoption, innovation, and investment in GPS. *These specifications need to support the needs of the installed base at least as well as provided by current signals*. To do otherwise will merely encourage international investments to flow toward foreign systems that are willing to provide stable, open specifications that meet the expectations of today's global users.

The *U.S. Space-based Positioning, Navigation, and Timing Policy* of December 2004 includes a goal that says the United States should field capabilities that ensure we have the "pre-eminent military space-based positioning, navigation, and timing service." There is much to admire in this policy, which continued the foundation laid by the 1996 GPS Policy of the Clinton Administration, but I would suggest deleting the qualifier "military" after "pre-eminent." Given our nation's reliance on GPS, there is no place for being second in civil or national security applications.

The major challenges facing GPS can be placed into four general categories:

GPS Modernization: Keeping the GPS Block III satellite acquisition on cost and schedule is crucial to preventing or minimizing gaps in GPS coverage. In particular, fielding satellites with additional signals "L2C" and "L5" to benefit civil and aviation users worldwide is critical to maintaining U.S. leadership in positioning and navigation services. Other improvements include: (1) a modernized search and rescue capability to replace the aging COSPAS-SARSAT network; and (2) laser retroreflectors to enable precise GPS satellite position measurements needed to continue improving the underlying geodetic reference frame and analysis of orbit determination errors. Next-generation air traffic management systems such as "ADS-B" appear to require more GPS satellites than formally required for Defense users. Thus the current Department of Transportation funding line for civil GPS improvements may need to be increased.

Spectrum Protection: GPS signals are faint and adding power in space can be prohibitively costly. Thus it is vital to protect the radio spectrum used by GPS from intentional (e.g., hostile) or unintentional (e.g., commercial) interferences. GPS is a global utility that supports a variety of safety applications around the world so international cooperation is important to maintain regulatory protections for the spectrum used by GPS. At home, the FCC and NTIA have important roles in preventing interference to GPS from commercial products and services. Continuing enforcement attention is needed to prevent or remove sources of interference in bands used by GPS as wireless technologies evolve.

International Relations: Discussions with the European Union are seeking to resolve questions on whether timely access to Galileo signal information will be implemented in a non-discriminatory manner. In contrast, Japan is seeking to build an augmentation system "QZSS" which is fully compatible with GPS and there is a long history of quickly resolving GPS trade-related questions with Japan.

Government Management: The stability of GPS policy across multiple Administrations and Congresses has greatly contributed to the trust shown by the large number of GPS users around

the world. No changes in national policy or management structure are needed, however the effective management of GPS requires a continuation of the strong interagency partnerships and White House oversight that has helped ensure U.S. leadership in this crucial area. Particular attention needs to be paid to assuring that appropriations for GPS and its augmentations are well coordinated to assure the most efficient modernization effort possible.

The fundamental issue is trust. The United States has earned global trust in GPS from over two decades of operational excellence and policy stability. It is ours to lose.

Thank you. I would be happy to answer any questions you might have.

Scott Pace

Dr. Scott Pace is the Director of the Space Policy Institute and a Professor of Practice in International Affairs at George Washington University's Elliott School of International Affairs. His research interests include civil, commercial, and national security space policy, and the management of technical innovation. From 2005-2008, he served as the Associate Administrator for Program Analysis and Evaluation at NASA.

Prior to NASA, Dr. Pace was the Assistant Director for Space and Aeronautics in the White House Office of Science and Technology Policy (OSTP). From 1993-2000, Dr Pace worked for the RAND Corporation's Science and Technology Policy Institute (STPI). From 1990 to 1993, Dr. Pace served as the Deputy Director and Acting Director of the Office of Space Commerce, in the Office of the Deputy Secretary of the Department of Commerce. He received a Bachelor of Science degree in Physics from Harvey Mudd College in 1980; Masters degrees in Aeronautics & Astronautics and Technology & Policy from the Massachusetts Institute of Technology in 1982; and a Doctorate in Policy Analysis from the RAND Graduate School in 1989.

Dr. Pace received the NASA Outstanding Leadership Medal in 2008, the U.S. Department of State's Group Superior Honor Award, *GPS Interagency Team*, in 2005, and the NASA Group Achievement Award, *Columbia Accident Rapid Reaction Team*, in 2004. He has been a member of the U.S. Delegation to the World Radiocommunication Conferences in 1997, 2000, 2003, and 2007. He is a past member of the Earth Studies Committee, Space Studies Board, National Research Council and the Commercial Activities Subcommittee of the NASA Advisory Council. Dr. Pace is a currently a member of the Board of Trustees, University Space Research Association.